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Mushroom News

A QUARTERLY JOURNAL FOR MUSHROOM GROWERS

Vol. VII No. 6 OCTOBER 1959

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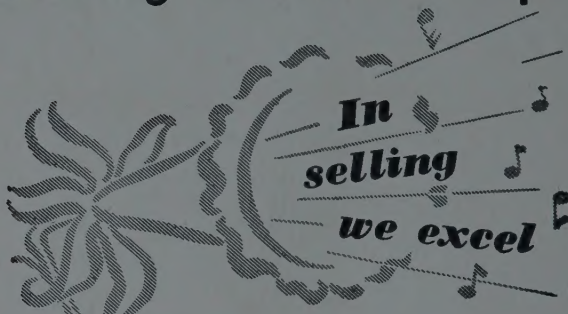

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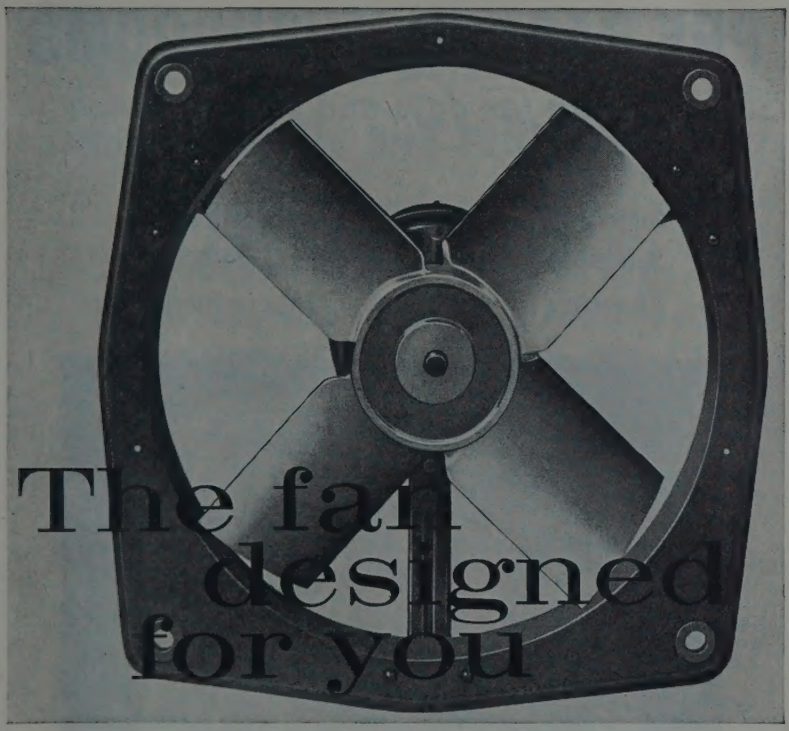

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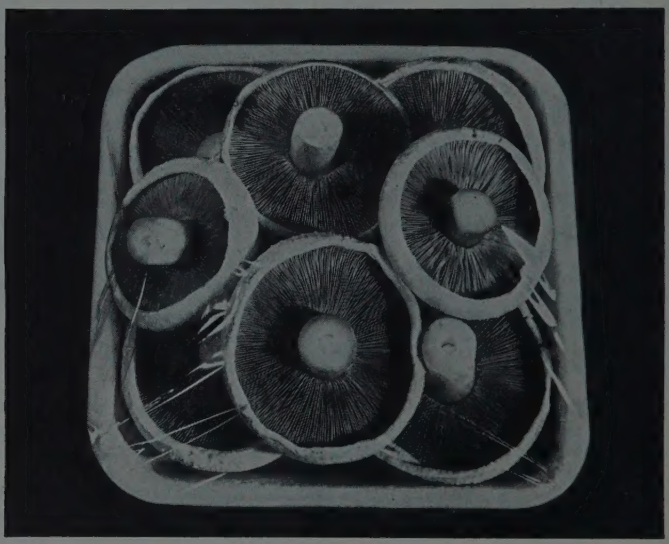

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Mushroom News

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OUR FRONT COVER

An M.G.A. Farm Walk was held at Mr. J. G. Batchelor's Borrow House Mushroom Farm, Churt, Surrey on the 19th September. Our front cover shows one of the cropping houses, the mushrooms grown from 100% Productive Moist Manure Spawn.

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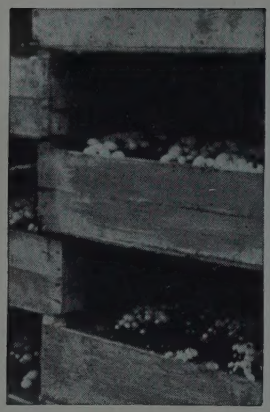

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WORTHING ENGLAND

Vol. VII No. 6 **OCTOBER 1959**

The Size of It.

If it were possible to measure progress in some clearly understandable unit, there can be no doubt that the cultivation of mushrooms would rate high in any comparative table. Much of what was discussed at the 4th International Mushroom Conference at Copenhagen in July would be incomprehensible to a Rip van Winkle mushroom grower from a mere fifteen years back, and a modern intensive farm in comparison with a pre-war unit would resemble an atomic power station against a gasworks.

In this era of five-week cropping, of rapid fermentation and self-feeding manure turners, is there still room for the small grower with limited mechanical resources and unspecialised houses? The answer is a most emphatic yes, provided that the small grower is efficient, producing good crops of high quality. For if our Rip van Winkle were to visit the markets and shops he might be even more surprised by what he saw displayed for sale than he had been by changes on the mushroom farm.

High pressure production does not lend itself to high quality; marketing of astronomical quantities of mushrooms in widely separated parts of the country is not conducive to giving the public top grade produce. Consequently the grower who markets good mushrooms, well graded and well packed, will always find a steady demand for his wares at an enhanced price.

Furthermore, on the small farm almost every cultural operation is carried out under the guv'ner's eye — often he participates in them himself. Personal supervision by the man most interested in efficient and economic production is worth quite a lot of mushrooms, and a general saving in overhead costs too! By personal contacts he can establish outlets for his produce at prices that remain good throughout the year, and we often hear from small growers who are swamped with orders for their own special brand of mushrooms, when there is a glut in the city markets.

At a time when it is suggested that the problem of stalks be solved by leaving them on the mushroom, it is always good to learn of growers whose strict adherence to the standards of grading laid down has resulted in increased market returns. Mr. H. Ososki, a retailer, writing in the April issue of this journal, stressed that length of stalk, unclean produce, refrigeration, mixed grades, over-packing and short weight, were the main

causes of adverse comment by purchasers and these are all matters that command the attention of the smaller grower.

In recent years we have seen a number of growers give up mushroom growing, claiming that it was no longer possible to make a living and that the big growers have ruined the market. Sometimes their idea as to what constitutes 'making a living' was somewhat inflated, sometimes their profits had disappeared because their cost of production reflected inefficiency in management. We number amongst our customers many small growers who can still make a good profit out of mushroom growing, but they do not expect an easy living, and are prepared to put as much into their mushrooms as they would into any other comparable horticultural crop in the expectation of a similar return.

Commercial mushroom growing started with the small growers, and will continue with a strong backbone of small growers, many of whom will still be cultivating their mushrooms when some of the bigger enterprises have gone over to broilers or rhubarb. The number of square feet a man cultivates is no measure of his efficiency; the yardstick is what he grows, what it costs him, and what price he sells at.

Notes and News

Insulation.

Bitumen Bonded Fibreglass has covered many thousands of square yards of mushroom houses, for it has proved to be the best possible form of insulation, easy to apply and virtually indestructible.

It has now been withdrawn and its place taken by a new product — Fibreglass Crown 75. This material is of finer composition and therefore has many more of the air spaces that provide the insulating quality, and additionally it is claimed that it does not cause skin irritation during handling. The price is the same, the only difference being that the rolls are twice as long — sixty feet by four feet.

Fourth Short Course.

One hundred and forty people, representing growers, packers and canners attended the U.S. Fourth Short Course for the Mushroom Industry at Pennsylvania State University in June. Mr. and Mrs. Graham Griffiths from Congresbury, Somerset, made the journey from England.

Lectures covered all aspects of growing and marketing mushrooms. The Director was once again Dr. Leon R. Kneebone, who is director of mushroom research at the University. The American Mushroom Institute's annual award for the outstanding contribution to the mushroom industry went to Walter W. Maule.

Glasshouse Census.

The Ministry of Agriculture's Glasshouse Census figures show a drop of one acre in the glass devoted to mushrooms in January 1959. The figure for that month was 36 acres compared with 37 acres twelve months before.

Areas devoted to various crops all dropped in 1959, with the exception of carnations, bulbs for forcing, and chrysanthemums.

(Continued on page 106)

FOURTH INTERNATIONAL MUSHROOM CONGRESS

COPENHAGEN

20th—23rd July, 1959

Scientists and mushroom growers from many countries assembled in Copenhagen for the Fourth International Mushroom Congress. As well as visits to Scandinavian mushroom farms there was a schedule of more than 60 papers presented to the Congress by well-known figures in the international mushroom world.

OVER three hundred mushroom growers and their wives from twenty countries attended the Fourth International Mushroom Congress held in Copenhagen at the end of July. More than fifty growers and their wives from the United Kingdom were in the M.G.A. party.

The Congress was opened by Professor N. Thorkil-Jensen, Rector of the Royal Agricultural College, who gave a short address of welcome, and he was followed by Professor H. K. Palindan, Congress President, and Dr. Cecil Treschow, the Vice-President. The opening day was completed by a visit to the Danish Mushroom Research Centre in charge of Mr. C. Riber Rasmussen who was later to present four papers to the Congress.

Papers on mushroom science — over 60 of them — were read on four succesive days, and then came visits to the famous Carlsberg Brewery, and to the farms of three leading Danish mushroom growers. Visitors were also able to cross into Sweden and inspect Fammarps, the largest farm in that country.

Then came the closing banquet and many tributes to the excellent

C. Riber Rasmussen, Organising Secretary.

work of Mr. C. Riber Rasmussen and his organising committee, who had made the Congress a resounding success.

The most interesting of the four papers presented by C. Riber Rasmussen of the Mushroom Research Station, Copenhagen, at the International Mushroom Congress was the one entitled "Shake-up Spawning". This new technique is an extension of "through-spawning"—the practice of an increased rate of spawning coupled with the mixing of the grain spawn right through the compost. Contending that an increase in the amount of spawn used during spawning leads to higher yields, Mr. Rasmussen said that it was fairly expensive to increase the spawning rate. "Shake-up Spawning" acts in the same way as the use of more spawn per unit area of bed, but the spawn is produced in the compost.

Seven to fourteen days after spawning (depending upon conditions) the compost is "shaken" up

thoroughly in the beds or trays or tipped into a special mixing machine. At the time the mycelium more or less disappears to the naked eye but soon shows vigorous growth again. Pinheads appear on time and total yields increase. This is due to the hyphae of the mycelium becoming widely distributed throughout the compost at the time of "Shake-up" and this extends the possibility of the spawn to absorb the maximum amount of nutriments from the compost.

In experiments carried out at the Research Station non-treated compost gave yields of 2.53 lb. per square foot, while "shaken-up" compost gave 6.45 lb. per square foot — a truly startling increase, and it was not possible to find any other explanation than the shaking-up of the spawned compost. The only variation was that bed temperatures in shaken-up beds were 2 to 4 C. higher than in untreated beds, and this Mr. Rasmussen attributed to the greater mycelium activity in the compost.

A remarkable feature of the experiments was that at the end of cropping the compost in the untreated beds was thick with mycelium, while the treated beds showed very little mycelium left and had a musty odour. The reason for this might be that the activity in the treated beds caused some form of self-poisoning, or alternately that the shaking-up process weakened the hyphae in some way so that they could only maintain their normal shape for a limited period of time.

In a second paper, Mr. Rasmussen gave details of further experiments with pig manure. Summarizing work to date, he said that pig manure offers a very good substitute for horse manure and it can be used without the addition of other organic manures. However pig manure requires much less water than horse manure, that it tends to be far more greasy, and that peak heating is essential.

In the latest series of experiments, various composting times were tried and it was shown that a short compost of 7 days showed advantages and a tendency for higher yields. The addition of gypsum gave increased yields, but addition of various supplements did not appear to give more mushrooms. Adding water at filling was beneficial, but the opposite result was achieved when water was added after peak heating.

In his third paper, Mr. Rasmussen discussed experiments on controlled air movement and its effect on cropping yields. Using a special closed chamber, various air circulations over the beds were tried out and it was found that an air circulation corresponding to a 'speed' of 16 to 20 circulations per hour produced yields that did not alter significantly even when the 'speed' was increased to 32 circulations per hour. The vital point for growers was the discovery that air/bed ratios become insignificant if sufficient air movement over the beds can be ensured.

In his final paper Mr. Rasmussen looked into peak heating and its effect on cropping yields. He stressed that while different peak heating techniques have a marked effect on yields, when compared with no peak heating at all, incorrect peak heating technique can give drastically reduced yields. Peak heating is now considered part of the fermentation process and is carried out as such, using controlled air introduction.

Interior of the Conference Hall while lectures were in progress.

Despite the number of peak heating techniques at present practiced there appears to be no significant variation in yields; thus one grower may compost for a long time outside and then peak heat for 24 hours, while another will compost for only a very short while in the yard and then peak heat for ten days.

He put forward the conception that although it appears possible to correct compost by means of prolonged peak heating, this does not result in the type of fermentation that occurs naturally in the compost heap. The main effect is probably one of 'conditioning' the compost by removing inhibiting substances such as toxic agents, ammonia etc. His experiments showed that the period of peak heating can be much reduced, and a compost can be produced that requires only 'pasteurisation' without the introduction of air.

In a paper on "Studies on Horse Manure Compost and Mushroom Yields" E. L. Pennell and J. C. Bovenkerk gave a detailed examination of horse manure in the Chester County Area of the U.S.A. They gave details of the seasonal variations, and in their trials they found that yields varied greatly with the quality of the manure.

They point out that it is almost possible to gauge the activities of the horse world by analysis of seasonable supplies of manure, and they show figures of crops of from 1.23 lb. per square foot to 2.20 lb. per square foot from equal weights of different, unsupplemented manure.

In a paper on pasteurization room design and construction, T. O'Connor from Lugarno, N.S.W., gave facts and figures on how to build the perfect pasteurization room. He stressed the vital importance of effective insulation as a means of reducing costs of fuel and depreciation, and showed various thicknesses of insulation that are necessary if condensation inside is to be avoided. For suitable pasteurizing room conditions about two inches of insulation are required for each 20°F difference in temperature and outside temperature. Thus for an outside temperature of 60° and a room temperature of 140° approximately 8 inches of insulation are required.

Humidity can be controlled by fine water atomisers mounted below the air circulation fan and directed on to an electrically heated hotplate where the water is converted into steam. The steam rises and is then circulated through the room by the fan. A humidstat mounted immediately behind the fan controls the water sprays.

Sixty-eight papers were presented at the Conference and included contributions by Mr. F. W. Toovey, Director of the Glasshouse Crops Research Institute, Toddington, outlining mushroom research in this country, by Dr. N. W. Hussey on the Biology of Mushroom Phorids, by Miss D. Gandy on her Preliminary

Investigations into "Watery Stipe" and by I. F. Storey and E. Lester on the Watery Stipe Disorder of Mushrooms. Other U.K. papers included one by P. B. Flegg on the Function of Compost and Casing Layer, a further paper by Dr. N. W. Hussey and I. J. Wyatt on Cecid Control, and one by G. W. Chapman on the Pot Culture of Mushrooms in the Small Laboratory.

E. Hauser and J. W. Sinden presented a paper on Industrial Research and investigations into some factors affecting yield. They produced figures showing that increased rate of spawning — more spawn per unit of bed area — gave a markedly faster spawn run with consequent reduction in the time between spawning and picking, when the spawn was thoroughly mixed into the compost. Yield was most definitely influenced by rate and method of spawning. They went on to show that yield is also directly affected by the weight of compost per unit of bed area, when through spawning at a heavy rate is carried out.

Notes and News *(Continued from page 102)*

Dutch Research.

The Dutch Mushroom Research Station at Horst, was opened by the Netherlands Minister of Agriculture and Fisheries on the 6th July, 1959. As well as the many Dutch growers present, there were visitors from England, America, Denmark, Germany, France, Switzerland and Belgium.

In a special message to the visitors, Dr. P. J. Bels, the Director, said: "I hope that the work of the Mushroom Experimental Station will always keep its international orientation because the exchange of ideas, born from the various ways of growing in the different countries can help us in solving our special problems".

Tomatoes.

For one month from the 19th August the Tomato and Cucumber Marketing Board imposed a ban on the sale of undersized and blemished tomatoes. The order came as a result of the rock-bottom level of prices obtaining, and had the purpose of stopping sub-standard tomatoes from reaching a depressed market.

The new Dutch Research Station at Horst on the Opening Day.

This is the first time the Board has used its powers to control the quality of the produce registered growers send to market, and it is a decision that will no doubt lead to some controversy.

In Memoriam

Giuseppe Tentori, the Italian writer and lecturer who specialised in fungi and particularly mushrooms, died in Lugano recently.

Signor Tentori died—of mushroom poisoning!

" Bitter experience has taught them that if an area of ground is forced to produce the same crop year after year it will turn sour on them."

COOKING OUT

In this article we discuss the question of introducing an artificial break into the cropping schedule so that build up of pests and diseases from one crop to another can be interrupted, and new crops can be started in houses free from 'carry-over' from the preceeding crops.

IT is often a source of exasperation to specialist mushroom growers to learn of record first crops picked by newcomers to the industry on their recently erected farms. 'Beginners' luck' appears, at least superficially, to be the rule rather than the exception in mushroom growing. Not so well-known to specialist growers are the remarkably good yields regularly obtained by the winter growers who cultivate mushrooms as a catch crop. It is true that these winter growers usually adopt different cultural methods to those practised on modern intensive plants, but even allowing for this, winter growers rarely suffer from troubles that beset the specialist.

Both beginners in their new houses, and winter growers in their tomato houses, have one common factor. They are both starting fresh — in the case of one, in a situation that has never known mushrooms, and in the other, after a long break of eight to nine months. It would be correct to say that only in exceptional circumstances, such as a hot summer, will an outbreak of trouble build up in one crop to epidemic proportions and call for an all-out offensive to regain control. Consequently the beginner and the winter grower, starting from fresh, do not inherit a legacy of trouble from their previous crops.

For the intensive grower, however, there is no "natural break", during which his farm has the opportunity to rid itself of the seeds of trouble. Crop must follow crop in a tight schedule that allows no more time than it takes to clear out one house of spent compost and refill it. The spent compost itself is emptied into lorries for removal and no matter how careful the grower is, there is always the possibility of the re-infection of other houses by airborne spores or pests, disturbed during emptying.

On the intensive farm there is a very real danger of a gradual build-up of trouble by carry over from one crop to the next. A patch of *Verticillium* in one house will contaminate the next crop, and the trouble will grow until soon large areas are affected and the disease will spread to the other houses right through the farm. La France, Mat, Springtails, Eelworm, are but four of the troubles that can start in a small way and build up to serious proportions through carry over. Often the elements of four or more diseases may be present on the farm at the same time, each quietly sapping away the crops so that yields are steadily reduced over a period, yet the grower is unable to put his finger on the reason. Eelworm may be identified by the consultant, and steps are taken to eradicate the pest while the other causative factors are ignored.

Growers of mushrooms are inclined to forget the old rule of 'rotation of crops'. Farmers allow their fields to lie fallow for at least one year in four, and glasshouse growers steam and sterilise their soil at regular intervals. Bitter experience has taught them that if an area of ground is forced to produce the same type of crop year after year, it will turn sour on them and their yields will fall to the danger point.

Reduced cropping over a period of years has affected a number of farms. Old records are consulted, showing that average crops used to be far higher. The blame is placed on the quality of the manure, modern methods, the strain of spawn and so on, and it is a brave grower who will face up to what is often the truth — that he has probably got at least half a dozen things wrong with his farm at one and the same time, and interacting with each other they have a cumulative effect on crop yield.

The 'natural break' of several months is obviously the best method of breaking the cycle of trouble on the mushroom farm, but it is equally obvious that such a break cannot be made part of the schedule on an intensive farm. During the summer months when prices are bad and cultivation difficult, some intensive growers are running at half speed, taking the opportunity to introduce a partial break by resting houses in turn, giving them a thorough spring-cleaning, and carrying out an intensive programme of sanitation. Even so, there are still houses cropping, and these must be cleared of spent compost with the consequent danger of re-infection.

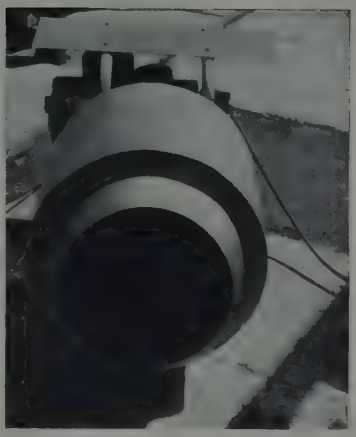
How then to introduce a dramatic break into the cropping schedule of the intensive farm that will interrupt the cycle of trouble without leaving houses standing idle? The answer is the process of cooking out.

To cook out a house at the end of cropping is to raise the temperature of the house to *at least* 130° F. for 24 hours. This is the *minimum* temperature and if means are available to raise the temperature to 160° F., then they should be utilised to the full.

The purpose of cooking out is twofold :—

(1) To eliminate all infection present in the spent compost in the trays or shelves, so that during removal from the farm there will be no risk of contaminating other houses.

(2) To eliminate all infection effectively from the house itself and all fittings and fixtures inside it, so that there will be no carry over



The Heat Sterilizer Unit, a useful means of obtaining cooking out temperatures.

of disease or pest on to the next filling.

Eelworm, one of the most difficult pests to eradicate from mushroom houses, provide an indicator as to whether the cook out has been effective. The thermal death point of eelworm found in mushroom compost should be realised if a temperature of 130° F. is reached and maintained for twelve hours. As an example, a sample of compost from a farm showed an eelworm population of 27,500 on extraction before cooking out was begun. After fifteen hours at 135° F. a further extraction was made and no eelworm were found to be viable.

Most modern mushroom farms have the means to raise temperatures above the necessary minimum, but we will go on later in this article to mention some of the auxiliary equipment available to boost house temperatures to the required minimum.

First, however, it must be clearly understood that no matter how high the air and compost temperature is raised, the temperature on the *surface of the floor* is unlikely to reach the necessary temperature for effective cooking out. Unless steps are taken to see that the floor also is suitably treated, the cooking out process is far from effective. The best method, therefore, is to commence the cook out by washing down the floor thoroughly with plenty of disinfectant, such as S.D.N.O.C., E.C.A.55, or Sterilite.

The floor must be washed down with disinfectant *before* turning on the heat. It will be obvious that unless the floor is treated first, the means of re-infection (the contaminated surface of the floor) will remain active throughout the cook out, and when the temperature is dropped, spores or pests that have survived will welcome the opportunity to re-infect the beds.

At the same time a study of the ceiling and walls will not be wasted. Where raw heat, as is supplied by the Heat Sterilizer Unit, braziers or Baxi Stove, is used the ceiling will remain dry and the air temperature can be relied on to provide the scouring action required. But if piped heat or live steam is used, there may be heavy condensation on walls and ceiling, especially if finished with asbestos sheeting, and pests such as eelworm may survive in the moisture droplets, to fall back on to the floor and permanent structures when the cook out is over. If there is any danger of this occuring, it would be advisable to brush or spray the whole of the interior of the house with S.D.N.O.C. solution.

With the floor disinfected, the house should be closed down and the heat turned on. However, it must be realised that any equipment in the house that can be damaged by high temperatures should be removed,

and this includes fans and blowers that do not have heat-proof features, electrical switchgear and so on. It is perhaps unnecessary to point out that anything removed from the house should be wiped over with a cloth soaked in disinfectant.

Where the farm is heated by steam, the heating installation may be adequate to supply sufficient live steam to force the temperature up to the required minimum and above. Where this is not possible, some auxiliary means of providing the boost for an effective cook out may be necessary. Some growers have considered it worth while to install a high-pressure steam boiler for the sole purpose of ensuring that their cooking out is 100% effective.

Of the various auxiliary sources of heat available, the Cob Heat Steriliser Unit is probably the most satisfactory. The Unit was fully described in "Mushroom News" Vol. VI, No. 5 (July 1957). The principle of the Unit is the conversion of gas oil directly into heat in a special combustion chamber, the heat then being released into the mushroom house. This conversion is carried out by a fully automatic burner which vaporizes the gas oil in a pressure jet. The vapour is completely burned in a drum-shaped combustion chamber and the heated products of this combustion chamber flow on into the house.

In well-insulated houses approximately 50 ft. long and 18 ft. span, air temperatures of over 200° F. have been obtained at relatively small cost in fuel. The Unit can be quickly and easily moved from one house to another, and setting up the apparatus presents no difficulty. The only essential requirements other than the Unit itself, are a nearby electric point and a drum of gas oil.

Some growers use braziers for obtaining the intense heat necessary for an effective cook out, and while they certainly supply the heat, they are not without danger, both from the point of view of setting fire to trays or wooden structures, and also from the risk of asphyxiation by carbon monoxide when workers enter the house to refuel the braziers. Both threats are avoided by the use of a Baxi Hot Air Stove. In this stove a central fire box, burning any combusitble material, heats up metal fins which in turn heat a column of air round the fire box. This heated air can either be ducted away through sheet metal ducts or released straight into the house. The dangerous fumes escape through a flue, and consequently there is no risk of carbon monoxide poisoning. The Baxi Stoves can be obtained in various sizes although it is probably best to invest in one or more of the Minor size, positioning them at either end of the house. The Stove can be dismantled quickly for moving, the essential requirements being a fire-proof base on which it stands, and an escape through the ceiling for the flue gases.

If it is realised that mushrooms are *still* one of a number of glasshouse crops, and must be approached with the same general principles of cultivation in mind, the cooking out process becomes as obvious a part of the cultural routine as the tomato grower's soil sterilisation programme. But when the grower embarks on a programme of intensive cultivation without taking steps to see that there is a break, natural or artificial, between crops, he can only expect reduced yields, increased infestation, and eventually uneconomical cultivation.

Visitors touring Huntick Farm during the Open Day

A NEW SORT OF OPEN DAY

A new sort of Open Day was held at Mr. J. H. Scrimgeour's Huntick Farm, Dorset, when the visitors were retailers and their friends, invited to see over the mushroom farm, inspecting packaging and publicity exhibits, and take tea while discussing the problems of selling mushrooms.

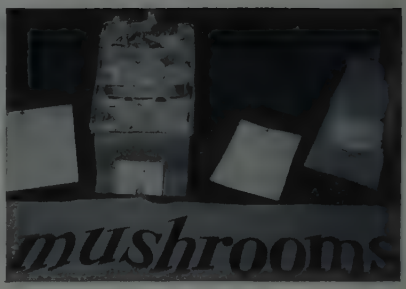
ON the 9th September John Scrimgeour demonstrated just what can be done by every grower who wishes to increase sales of mushrooms. He held an Open Day at Huntick Farm, to which he invited local greengrocers and their friends, and showed them how mushrooms are grown.

This is the second year he has thrown open his attractive mushroom farm near Poole, in Dorset, to the "Trade". He does a substantial volume of business direct to greengrocers in the district, and the personal contacts he has made led to many questions about mushroom growing that could best be answered by showing those interested the complicated processes involved in producing mushrooms. Invitations were issued, and some 40 retailers and their friends accepted.

They were shown round the farm, and expressed considerable surprise at the amount of work and expense involved in producing a pound of mushrooms for market; many said they would never again query the price of mushrooms which they had previously considered to be far too high!

Tea was provided for the guests, and there was a display of packing and publicity material. Mr. Scrimgeour has devised chip basket covers that will stand up on the basket, with a space for the price to be marked in, and the slogan "Eat Cultivated Mushrooms for Sheer Enjoyment". Prepacks were also on display, and copies of "Winning Ways with Mushrooms" and other publicity material.

Mr. Scrimgeour's "Do it Yourself publicity campaign also includes a direct attack on the consumer in the form of free sample packs sent to selected people, containing ½ lb. mushrooms at one end and a rose



A corner of the display of packing and publicity material. The chip basket is the presentation pack Mr. Scrimgeour sends out.

at the other. The sample pack is completed with a letter drawing attention to the virtues of the mushroom, and where supplies of Huntick Farm mushrooms can be obtained. These sample packs have produced very favourable results.

Mr. Scrimgeour claims that his publicity campaign is relatively inexpensive, and produces really concrete results, not only in increased sales but in creating bonds with the retailers and through them, the public. It is something that every mushroom grower can do, and even if he does not have a local trade, he can still interest and influence many retailers in the district, leading to an increased demand for mushrooms through the wholesale markets. To the general public a mushroom farm is a mystery; the more people who see mushrooms being grown the better, for they will talk of their unique experience to their friends and the magic word will be passed from mouth to mouth until mushrooms are regarded no longer as an expensive luxury but a rather special vegetable that is well worth buying for the 'sheer enjoyment' of eating it.

MODERN MUSHROOM EQUIPMENT

THE CATTER HEADLAMP

Growers and their managers will welcome this lightweight headlamp that can be slipped in the pocket when not in use, and yet gives ample light for inspection when required.

THE CEAG Type A7 Cap Lamp remains the most efficient method of providing 'on the spot' illumination for the worker in the mushroom house. However, the equipment is heavy, even with the Type A5 Battery of two cells instead of three, and it is not the sort of thing the manager or foreman can slip on at a moment's notice to check on spawn run or a patch of mould on the casing.

The Catter Headlamp is a lightweight battery-operated lamp that is made of moulded plastic, held in position by an adjustable elastic strap. The lamp can be moved on trunnions to any angle that suits the wearer's wish.

The lamp is powered by two of the small pencil-type batteries, which are quickly inserted at the back of the case. A switch on the case itself operates the lamp.

The Catter Headlamp is priced at 8s. 6d. plus 1s. 9d. Purchase Tax, and the Type 1915 batteries are 4½d. each, two being required.

PESTS OF THE CULTIVATED MUSHROOM

No. 5 MITES

by

MARTIN D. AUSTIN

Mr. M. D. Austin continues his series on the pests of the cultivated mushroom, and in this article he discusses mushroom mites, and the methods that growers use to combat them.

MITES of one species or another will almost certainly be found to be present, in greater or lesser numbers, at each successive stage in the sequence of cultural processes involved in mushroom cultivation.

This is hardly surprising since there are but few commercial crops which, somewhere along the line towards maturity and even beyond and into the storage phase, do not support a mite population.

These small and ubiquitous arthropods are so adaptable to any environment in which they occur, invade or are introduced that within certain limits even gross fluctuations in temperature, humidity and the like appear never completely to check their forward march. Indeed such is their universality and tenacity that they achieve a successful way of life in the face of considerable hazards in nearly all parts of the world.

They are well sustained in this respect by their fairly rapid life-cycle and particularly by their ability to build up from a comparatively few individuals to massive populations. The rate of breeding — biotic potential — of most mite species is so great that even where subjected to conditions seemingly quite unfavourable to their devel-

Mite damage to the cap of a mushroom during cropping.

opment, a mere trifling number of survivors — the few — soon becomes the many.

A number of mite species are specific to either a single host plant species or to a very restricted range, whilst others, more catholic in diet, have a large number of host plants species. Still others live and feed in accumulated plant debris, straw, manure, stored foodstuffs such as grain and flour and also food products. Thus both the kitchen and the cattle byre and the barn can support mites, which, because of their normally minute size, generally are not noticeable until the populations have considerably increased. Indeed phytophagus mites sometimes cause the most significant damage to their host plants *before* their own presence is observed.

A large number of mite species are predatory in habit thus certain mite pest species are affected by predation.

Naturally since mites so frequently occur in very large numbers in a comparatively restricted area, some species are held well in check by a range of natural enemies including certain insects. A classic example of this is the ascendancy of a predator complex over even astronomical numbers of the Fruit Tree Red Spider mite when conditions favour the former. Since so many mite species are major pests of crops the generalisation — that the presence of even a few injurious mites should be a matter of concern — is quite acceptable. Certainly in connection with the mushroom industry the noted occurrence of mites within *any* part of the farm unit, be it the composting shed, the cropping areas or the packing shed or where you will, calls for immediate control measures.

Few who have experienced the full weight of mite attack on cultivated mushrooms would deny that mites can cause damage of real economic importance. Nevertheless there are some who are yet to be convinced that mites matter ! Despite this divergence of opinion and belief most growers are alive to the possibilities inherent in thriving mite colonies.

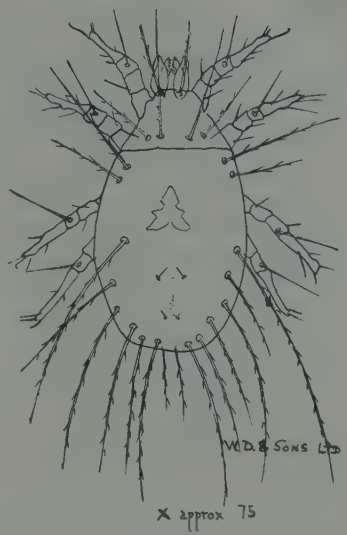
The fact that the 'Field Mushroom' and the 'Horse Mushroom' seldom support many mite species may suggest that where mushrooms are grown together and in very large numbers the risk of mite infestations arising is considerably increased.

Basically mites differ from insects in that as they approach maturity they become eight-legged and, further their bodies are *not* separable into the three distinct regions — head, thorax and abdomen — in fact, the head and thorax, for our purpose, may be considered to be fused together as one sirigle region.

Typically mites have no pupal phase such as occurs with many of the insect pests of mushrooms including the *Sciara* and Phorid flies. Thus very significantly effective mite feeding, with but little let-up covers the period from hatching from the egg, through the various nymphal stages and into maturity until death ensues.

It is this sort of thing which gives added importance to an organism's pest status, for if there is no appreciable period in its life when feeding is discontinued, it follows that the crop concerned has no 'breathing space' in which to recover temporarily, to become refortified and the better able to withstand attack.

However, with certain mite species, including some of those associated with cultivated mushrooms, there is a *very limited* period in which feeding is temporarily discontinued. Known



Mushroom Mite (Tyroglyphus dimidiatus) magnified 75 times.

as the hypopal stage, it is apparently an adaptive phase when the quiescent mites can become attached to other and much more active organisms such as certain fly species. In this phase suckers largely take on the place and function of their legs. It is in this phase that some injurious mite species are carried from one site to another, and it is in this manner that new infestations are initiated. Once the transient hypopal phase has passed the mite again becomes actively feeding and quickly regains its pest status.

The actual extent of the role of mites in the spread of mushroom diseases is possibly conjectural, but practical evidence suggests that they can at least effectively function as carriers of bacterial troubles.

Of the injurious mite species recorded authentically as occurring, in mushroom units, those belonging to the family *Tyroglyphidae*, which includes many fungus feeding individuals, are possibly the most common.

A generalised account of the appearance and life-cycle of these creatures is as follows.

They are very minute, always soft-bodied and of a rather whitish or translucent colour. Normally very sluggish they would hardly be noticeable if it were not for the fact that they eventually build-up into large populations. Typically rather globula in shape they are generally well supplied with relatively long and often delicate hairs. They feed by means of very specialised mouthparts largely adapted for dealing with tissues offering but little resistance, thus they are well suited for feeding on mushrooms and mushroom debris, mycelium and spawn pieces, and straw in a state of decomposition. Almost all the materials that go to make up a mushroom bed are vulnerable to these mites. One of the reasons why mushroom mites are such efficient pests is that their food materials completely surround them once they make their way into a mushroom unit !

Their small whitish eggs, of which each female may lay up to 30 or 40, are laid in a variety of situations including the casing soil, the compost and the gills of the mushrooms as well as within the mite-damaged portions of the mushrooms. These eggs hatch within a few days, giving rise to the six-legged larval mites which, feeding quite voraciously, enter the first so-called nymphal eight-legged stage within a matter of a few days. Within a week or so maturity is reached.

It follows therefore that from quite small numbers a massive and gross infestation of a mushroom bed

may eventually, and usually quickly, be established.

One of the more common species of the so-called mushroom mites is known scientifically as *Tyroglyphus longior* or *T. dimidiatus*.

Many mites other than these Tyroglyphids have been recorded as occurring in mushroom units; some of these are later referred to in the discussion on direct damage to the crop.

The damage caused by *T. dimidiatus* usually consists of shallow and irregular pits. These mite-made excavations in the mushroom may become relatively extensive and deep, and extend into the interior. In the case of smallish mushrooms and pinheads these may be completely hollowed out. Usually the interior of the pits is rather moist and also may be much discoloured by the mites' excreta.

Where infestations extend through the casing media and thus well into the bed itself the mycelium may be so much damaged by the mites as to result in a very obvious loss of crop potential. On the other hand, some mite attacks commence in the neighbourhood of the mycelium without any external and visible signs of its occurrence in the initial stages. The delayed cropping or non-appearance of mushrooms, and subsequent examination of the bed brings to light the root cause.

Whichever form the mite attack may take, the ultimate effect is crop reduction, for heavy attacks in the early part of the life of a mushroom bed may result in a total failure.

It is sometimes possible, with early control measures, to deal with a primary infestation centre and prevent the effective spread of mites to other parts of the beds or to other trays. Since mites are so readily carried from place to place within a unit, their control may not be easy.

The damage attributed to other mushroom mite species may at times vary considerably from that described above. For instance, Tarsonemid mite species such as *Tarsonemus tarsalis* one of the so-called 'Red Peper' mites apparently destroys the mycelium at the base of the individual mushrooms.

Injury somewhat similar to the foregoing is sometimes attributed to the very active and fragile Long-Legged Mushroom Mite (*Linopodes antennaepes*) which occasionally occurs in large numbers in mushroom beds. Since the noticeable and rapid mobility of a mite species suggests a predatory mode of life, it may be that *Linopodes* is not always a significant pest.

However, since 'pure' mite colonies (where all the individuals are of the same species) are not always and invariably common to mite attack it is perhaps wise to refer to the pests as the mite pest complex.

Frequently the conditions in the mushroom house appear suddenly to favour or encourage mite populations and sometimes the development of such populations follows on an out-of-step phase in the strictly cultural condition of a bed.

Thus in such conditions, where the environment has moved from the man controlled phase to an out-of-hand phase, not only do mites gain an ascendency over the crop but a pest-complex often emerges, where mites, flies, springtails and eelworms may have an opportunity of making an effective 'take over' bid for crop dominance. When this point is reached it is difficult to point to mites as the one critical factor : rather it seems that at this stage pests have won the day!

With mites it appears that there comes a point in their population build-up when the incidental effect of their presence, quite apart from the actual damage they cause, has a depressing effect on the cropping capacity of a unit.

It is with this in mind that it could be suggested that mites must be controlled very early in the economy of individual beds lest their dominance emerges far too soon. Even in satisfactorily cropping units the discontinuance of control routine serves to show that pest control is sometimes a good delaying action since end-of-crop troubles tend to increase.

The first step should be to remove any accumulations of either mushroom debris or spent compost in or around the unit. To dispose rapidly of the worked-out compost-cum-casing-medium. By steam heat or chemically to sterilise units as emptied.

To control all pests as seen, so to ensure a near uniformity of freedom from pests throughout the whole set-up.

Prevention must include the proper composting of all manure as received on the farm, for in this way also many of the mite species, so often brought in with the straw, will be checked. Even so it should be borne in mind that temperatures even as high as 148°F. do not necessarily bring about complete freedom from injurious mite species. Further, at any stage in composting, or indeed cropping, fly species may bring in mite species in the hypopal stage of development.

Nevertheless, since it seems likely that many mites enter via the straw some of the range of chemicals employed during the composting process may well effect a considerable degree of mite control.

The use of certain BHC and DDT dust formulations during composting, before and after casing the beds, and at appropriate times during cropping is widely advocated, as are sprays of gamma BHC. So, too, Nicotine sprays are used effectively.

Exceptionately good results against mites where Diazinon formulations are used have been reported: similarly the controlled application by spraying with HETP or TEPP brings about very satisfactory mite control. With some of these materials there are certain safety rules to be followed.

It becomes apparent that with the emergence and understanding of more and more positive details with reference to the incidence of mushroom pests it becomes equally apparent that the pest-complex of a mushroom unit must be considered as a whole.

Thus, where the use of *any* cultural or chemical means of control of any one specific pest is being considered, its probable effect on the whole pest complex must be envisaged. In this way it may yet be possible to bring about the control of pests, including the very damaging mite species, in a rational manner rather than awaiting the pests to cause visible damage before attempts are made to control them.

Finally it cannot be too often stressed that the best time to attempt control of injurious mites is when populations are small and manageable. For once their numbers become astronomical — as so often happens – nothing less than a near total wipe-out will suffice. Generally it is only in the initial stages of mite infestation that such control is likely to be achieved.

ROUND AND ABOUT

MUSHROOM GROWING IN ISRAEL

by

John L. Kessler

Accounts of mushroom cultivation in other lands are always of interest to growers in this country. Cultivation in Israel must be specially difficult because of the high temperatures in the summer and shortage of the right manure, yet the industry is thriving, as Mr. Kessler explains in this article.

IN March 1950, through the auspices of the Mushroom Growers' Association, I was visited by a mushroom grower from Israel named S. Kohn, who showed great interest in our small mushroom farm and was particularly thrilled to learn that I had myself spent some years in Palestine. He was most insistent that I should pay him a return visit, and so when my wife and I eventually made a three weeks' trip to Israel last November/December, Mr. Kohn was one of the first people we made a point of seeing. We received a most cordial welcome from him and his assistant, and he also arranged for us to see the other mushroom growers in the country, who were also most kind, and accorded us a very warm welcome.

Israel is a very small country with three main centres of population, Tel Aviv-Jaffa, Haifa and Jerusalem, and since the demand for mushrooms is limited, there are now only three growers and each one is established near and supplies one of these three urban centres.

Mr. Kohn lives in a communal settlement or "Kibbutz," named Matsuba in Lower Galilee near the border with Lebanon, in very attractive surroundings.

In the six years since I had seen him he had run into some quite serious trouble with the mushroom culture, particularly eelworm and Red *Geotrichum*, and he has become more interested in research work than in actual growing, so he now spends much of his time at the Technical College at Haifa working on eelworms and their fungus predators. He has also equipped a laboratory at Matsuba for day to day tests and examination of specimens, but most of the growing work is carried out by an assistant. I soon

The lower end of one of the American-type houses at Matsuba.

learned that mushroom growing in Israel presents many problems that do not seriously disturb us here, but on the other hand, if good crops are obtained, the reward is correspondingly greater, since the market price over there is about double what we average. The growing plant at Matsuba consists of two blocks of three growing rooms each staged up with seven high shelf beds contained in one flat roofed concrete building. These sheds are based on the older style American mushroom sheds, but they are equipped with cooling equipment to keep down the temperature in Summer, which would otherwise be too hot for satisfactory cropping.

Some disused tobacco curing sheds have also been used for mushroom growing, but did not prove satisfactory and so were abandoned. There is a boiler for peak-heating.

The Israel mushroom grower has considerable difficulty in getting sufficient and satisfactory manure. There are very few horses in the country now-a-days and the manure comes mostly from mules and donkeys, particularly those that are used to draw paraffin carts, from which the urban housewife obtains her supplies of fuel for cooking and heating — there being no piped gas. This manure is often received in a very dessicated condition and requires a great deal of wetting to bring it into any sort of shape for composting.

Casing material is another problem: peat and chalk are being used, but the first is a local sort obtained from bogs in the Huleh area in the north or from near Hadera in the coastal plain, but the latter source appears to have dried up owing to financial failure. In the place of chalk, a rather hard local limestone was used.

We visited the two other mushroom growers; one, an elderly man named Cranon at Neve Ilan, in the hills near Jerusalem, was formerly a mushroom grower in California and is now an instructor at the School of Mountain Agriculture and he grows mushrooms on a small scale and because he enjoys doing it, rather than for financial gain. His plant might be called a small scale copy of the one at Matsuba, but being about 3,000 feet up in the mountains climatic conditions for growing are more favourable, no refrigeration of the sheds is necessary, the natural breeze being used for ventilation and some splendid crops have been obtained.

Mr. Cranon showed us all around his farm and also the thin, coloured plastic containers in which he packs his produce in small "pre-packs".

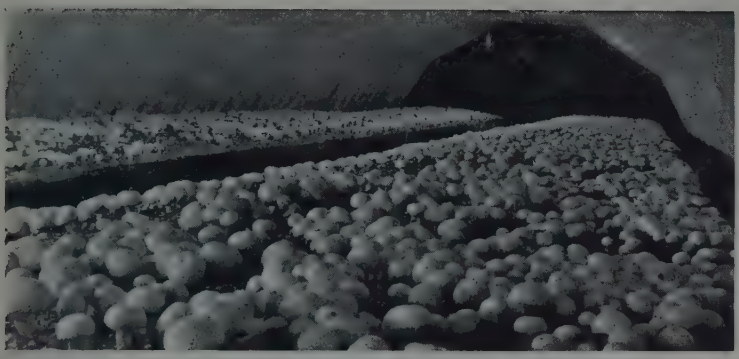
The third plant is at Ramat-Gan, near Tel Aviv, and here was quite a different story; we found a very young and very keen Israeli who had managed to buy out a considerably

Filling the American-type houses at Matsuba; the top gangway, entered from the upper end of the house is being used.

larger tray-system plant from the previous owner who had failed and the new owner in only three years has made a great success of the business. The trays were quite substantial wooden boxes stacked in four growing chambers opening off a central passage, the whole plant with pasteurising chamber being contained in a single building. I was not greatly impressed by the quantity of mushrooms I saw on the trays, but the owner assured me that he is getting very good crops and it was obvious that he is putting drive and hard work into the undertaking and his scale of living supported his contention that he is doing very nicely. He fired technical questions at me and it was obvious that he keeps up to date by reading and he was keen to know of any recent developments in England.

Our mushroom tour took us to one other place of interest and that was the Faculty of Agriculture of the Hebrew University, situated among the orange-groves of Judea at Rehovoth. Here once more we were made more than welcome, this time by a young American named Bob Kenneth who has done some useful research work on strains of mushrooms, particularly in collecting wild *Psalliota bispora* which he found growing under trees, and running cropping tests. As a commercial proposition, the results were disappointing, but Mr. Kenneth thinks something could still be done to improve commercial mushroom varieties by going back to reselected wild forms. At present he is engaged in research work on diseases of Barley, but mushrooms are his real love and he hopes to be able to return to them one day and provide us all with a new variety. We wished him good luck and were sorry to leave his stimulating company, but our time was running out and we had to board our Viscount for the flight home.

The interior of one of the growing houses at Matsuba.



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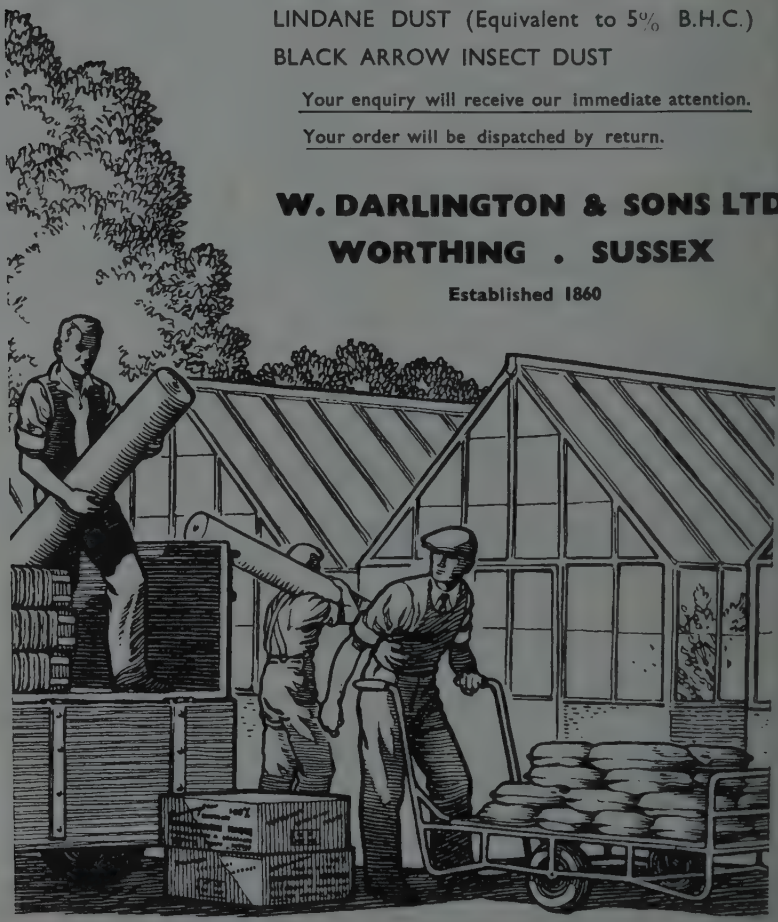

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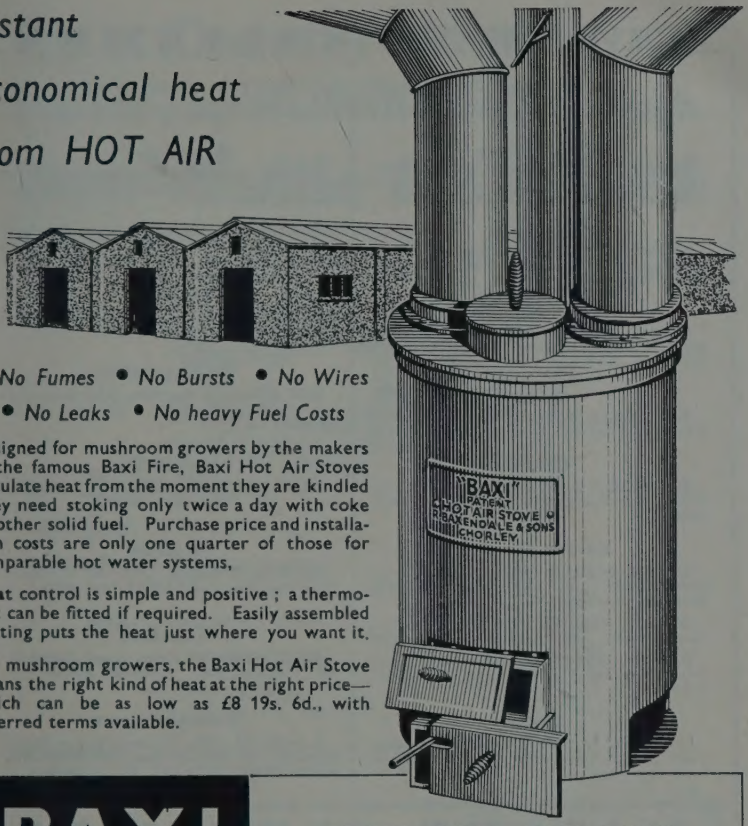

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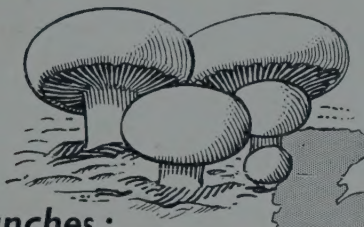

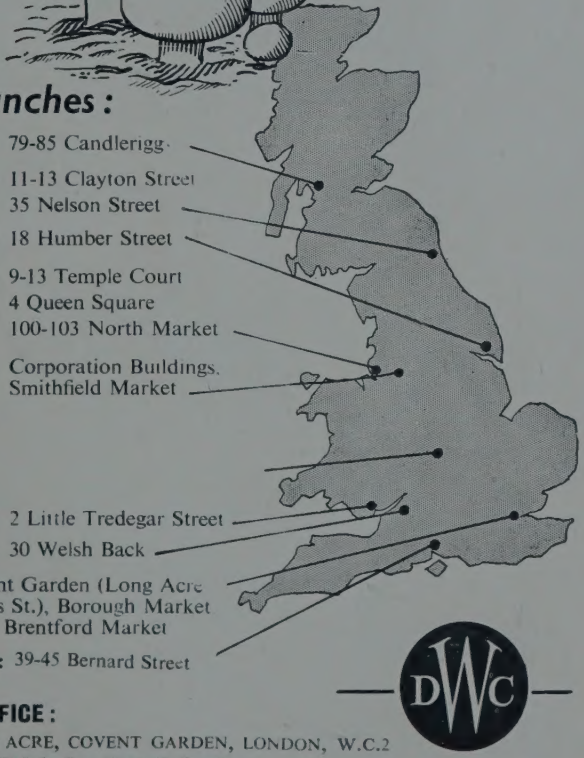

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